REMARKS/ARGUMENTS

Claims 1-15 are pending in the application. The specification has been amended to correct errors therein. Claim 14 has been amended to correct an inadvertent grammatical error. The amendment to claim 14 was not made to overcome any prior art rejection. The Applicant hereby requests further examination and reconsideration of the application in view of the foregoing amendments and these remarks.

Claims 1-15

At page 2, paragraph 2 of the Action, the Examiner rejected claims 1-15 under 35 U.S.C. 102(b) as being anticipated by Friedman et al., U.S. Patent No. 6,292,065 ("Friedman"), and on page 4, paragraph 1 of the Action, the Examiner rejected claim 9 under 35 U.S.C. 103(a) as being unpatentable over Friedman in view of Scoggins, U.S. Patent No. 6,469,587 ("Scoggins").

For the following reasons, the Applicant submits that claims 1-15 are allowable over the cited references.

Friedman discloses an inductor-capacitor (LC) voltage-controlled oscillator (VCO) that includes an oscillator module coupled, via first and second tank nodes, to a control module. (Abst.; col. 2, line 40, to col. 3, line 3.) The control module receives a differential control voltage across a pair of input voltage terminals. (*Id.*) The control module includes four voltage-dependent capacitive elements (VDCEs), e.g., varactors, which are configured to be biased for operation as voltage-dependent variable capacitances. (*Id.*) The VDCEs are interconnected such that the effect of a common-mode input voltage is to increase the capacitance of two of the VDCEs, while simultaneously decreasing the capacitance of two of the other VDCEs by a substantially similar amount, such that a differential voltage applied across the positive and negative input voltage terminals is operable to change the capacitance of the VDCEs, and thereby the frequency of the oscillator module. (*Id.*) Conversely, a common-mode voltage applied across the positive and negative input voltage terminals tends to cancel any effects on the output frequency of the oscillator module. (*Id.*)

Scoggins discloses a differential voltage-controlled oscillator (VCO) employing a pair of accumulation-mode varactors driven with a differential control voltage to generate a differential oscillating waveform. (Abst.; col. 2, line 65, to col. 3, line 19.) The differential control voltage is formed from a pair of level-shifted input differential control voltage components (e.g., varactors) coupled in a back-to-back configuration. (*Id.*) Level shifting of the input control voltages and driving the varactors with a differential control voltage allows for biasing of the varactors over a substantial range of

capacitance variation. (*Id.*)

Independent claim 1 recites, *inter alia*:

> a first varactor pair coupled to receive a first differential control voltage, the first control voltage i) sets a capacitance of each varactor of the first varactor pair and ii) provides a first level of adjustment to an oscillation frequency of the oscillating signal, and
>
> a second varactor pair coupled to receive a second differential control voltage, the second control voltage i) sets a capacitance of each varactor of the second varactor pair and ii) provides a second level of adjustment to the oscillation frequency of the oscillating signal, wherein the first and second levels of adjustment are different.

In other words, in addition to merely using two pairs of varactors in a tank circuit or a control module for a VCO, claim 1 requires the following four features (e.g., as shown in FIG. 3):

(i) that two differential control voltages exist (e.g., a first control voltage supplied across terminals V_{CP}, V_{CN} of FIG. 3 and a second control voltage supplied across terminals V_{CLGP}, V_{CLGN}), with each differential control voltage supplied to a different pair of varactors (e.g., first varactor pair CV_1,CV_2 and second varactor pair CV_3,CV_4);

(ii) that each differential control voltage set a capacitance of each varactor of the corresponding pair of varactors (e.g., by supplying the first control voltage across varactor CV_1 via nodes N1,N2 and across varactor CV_2 via nodes N1,N3, and by supplying the second control voltage across varactor CV_3 via nodes N4,N5 and across varactor CV_4 via nodes N4,N6);

(iii) that each differential control voltage provide a respective level of adjustment to an oscillation frequency of the oscillating signal (e.g., to permit coarse and fine adjustment, respectively, of the output frequency of the VCO, or to allow two different feedback control voltages to correct for frequency variations in a phase-locked loop (PLL) or delay-locked loop (DLL) application (col. 11, line 29, to col. 12, line 5)); and

(iv) that the two levels of adjustment be different from one another.

While Friedman does disclose the use of two pairs of varactors, Friedman falls short of disclosing, teaching, or even suggesting any of features (i) through (iv). As shown in Friedman's FIG. 1, a differential voltage is applied across positive input voltage terminal 118 (coupled to varactors 126, 128) and negative input voltage terminal 120 (coupled to varactors 122, 124) to change the capacitive properties of the varactors, so as to vary the output frequency of the VCO. (Col. 4, lines 20-24; col. 3, lines 4-5.) As to feature (i), the voltage supplied across terminals 118, 120 is only a *single* differential

voltage, not *two separate differential control voltages*, as claim 1 requires. Indeed, Friedman even states that "additional supply voltages need not be employed" (Abst.), and that "the invention does not require additional supply voltages" (col. 9, lines 55-56), clearly teaching away from the use of more than one differential control voltage, as recited in claim 1. As to feature (ii), since Friedman employs only a single differential control voltage, the requirement that each differential control voltage set a capacitance of each varactor of the corresponding pair cannot be satisfied. As to feature (iii), since Friedman employs only a single differential control voltage, the requirement that each differential control voltage provide a respective level of adjustment to an oscillation frequency of the oscillating signal cannot be satisfied. As to feature (iv), since Friedman employs only a single differential control voltage, the requirement that two levels of adjustment be different from one another cannot be satisfied. Since Friedman does not teach any of the foregoing four features required by claim 1, Friedman does not anticipate claim 1.

Similarly, independent claims 11 and 15 both recite that a first control voltage is "providing a first level of adjustment to an oscillation frequency of the oscillating signal," that a second control voltage is "providing a second level of adjustment to an oscillation frequency of the oscillating signal," and that "the first and second levels of adjustment are different." As explained above with respect to claim 1, Friedman does not teach first and second levels of adjustment that are different, and therefore, Friedman does not anticipate either of claims 11 or 15.

For all these reasons, the Applicant submits that independent claims 1, 11, and 15 are allowable over Friedman. Since claims 2-10 and 12-14 depend variously from claims 1 and 11, it is further submitted that these claims are also allowable over Friedman. The Applicant submits therefore that the rejection of claims 1-15 under 35 U.S.C. § 102 has been overcome.

<u>Claims 7 and 13</u>

According to claims 7 and 13, "the VCO is employed in a phase-locked loop (PLL) circuit, the first differential control voltage represents a feedback error for process variations of the PLL circuit, and the second differential control voltage represents a feedback phase error of the PLL circuit." (See p. 12, lines 2-5.)

While the invention of Friedman is described, generally, as having utility with PLL circuits, not only does Friedman fail to teach the use of two differential control voltages, but Friedman also fails to teach the desirability of making separate adjustments to the output frequency of the VCO for (i) feedback error for process variations of the PLL circuit and (ii) feedback phase error of the PLL circuit, respectively. This provides further reasons for the allowability of claims 7 and 13.

Claims 8 and 14

According to claim 8, the claimed circuit further comprises "at least one other pair of varactors, each of the at least one other pair of varactors coupled to receive a corresponding differential control voltage to i) set a capacitance of each varactor of the at least one other varactor pair and ii) provide a corresponding level of adjustment to the oscillation frequency of the oscillating signal." The "at least one other pair of varactors" is in addition to the "first varactor pair" and "second varactor pair" recited in claim 1, from which claim 8 depends. Similarly, according to claim 14, the claimed circuit further comprises "at least one other variable capacitor, each of the at least one other variable capacitors coupled to receive a corresponding control voltage to i) set a capacitance of the at least one other variable capacitor and ii) provide a corresponding level of adjustment to the oscillation frequency of the oscillating signal." The "at least one other variable capacitor" is in addition to the "first variable capacitor" and "second variable capacitor" recited in claim 11, from which claim 14 depends.

One exemplary reason for the desirability of using more than two pairs of varactors (or variable capacitors, or similar devices, as set forth at col. 11, lines 1-7) and corresponding control voltages is described at p. 11, lines 8-19:

> [A] first varactor pair might be used to coarsely set the frequency of oscillation of the VCO when the oscillation is programmable, a second varactor pair might be used to finely adjust the frequency of oscillation in response to the feedback phase error of a phase-locked loop employing the VCO, and a third varactor pair might be employed to adjust the frequency of oscillation in response to temperature or other process variations.

Nowhere does Friedman teach, disclose, or even suggest the use of more than two pairs of varactors, variable capacitors, or similar devices. This provides further reasons for the allowability of claims 8 and 14.

Rejection of claim 9 under 35 U.S.C. §103

As explained above, Friedman does not teach, disclose, or suggest each and every element of independent claim 1. Scoggins fails to supply the missing teachings. Accordingly, neither Friedman nor Scoggins, nor any combination of Friedman and Scoggins, renders obvious claim 9, which depends from independent claim 1.

In view of the above amendments and remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

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